disclosure documents were included with the abandoned Application no. 10/446,239 (filed 5-29-2003) as well as with this pending application (filed 8-25-03). **I)** The October 25,1999 disclosure document describes the nuclear medicine application for conventional (gamma camera, PET) and Compton gamma camera imaging detectors. The new material describes "a new kind of gamma camera design that utilizes the concept of edge-on detectors as described by Nelson in patent 4,937,453". "Drift and single-sided or double-sided strip detector configurations can be implemented depending on the semiconductor material chosen." "In the case of double-sided strip detectors electrons and holes can be collected to provide 2-D position information across the aperture or depth of interaction information can be acquired." (The aperture is the edge of the detector plane of thickness "H" that intercepts the incident radiation. The 2-D aperture position information refers to the physical readout strips (such as anode strips) along the length of the aperture and the electronically-determined event position across the aperture height "H" (the plane thickness) is the interaction height. Information about the aperture "interaction height" position of an event defines the 'aperture resolution' (also referred to as 'sub-aperture resolution' in this pending application.) Thus a single 2-D detector plane with aperture resolution can function as a novel edge-on, 3-D detector in an edge-on geometry. In a similar fashion a 1-D detector plane with aperture resolution can function as novel edge-on, 2-D detector. Geometric configurations such as planar arrays, cylindrical (rings) arrays, and spherical arrays are described. (This information as well as additional information is provided in Patent No. 6,583,420 B1.) Thus, this disclosure explains the use prior edge-on, 1-D and 2-D detectors, depth-of-interaction capability, and aperture resolution for conventional (gamma camera, PET) and Compton camera nuclear medicine. **II)** The June 12, 2002 disclosure document describes using an edge-on (or strip) semiconductor detector that "has sufficient spatial resolution so that an event (photo-absorption or scattering) occurring within a detector element can be localized. ... Migration times for holes and electrons can be used to localize the event with respect to the two sides". This can be achieved with 2-D pixellated arrays (described in Nelson Patent No. 4,937,453 and Patent No. 6,583,420 B1) or 2-D crossed strip arrays (described in Disclosure document No. 464163 with a filing date of October 25, 1999 and Patent No. 6,583,420 B1). Edge-on and face-on 3-D detector geometries are described that can function as Compton cameras. The edge-on detector plane with electronically-determined aperture resolution and the face-on strip detector (Figure 3) with traditional electronically-determined interaction depth resolution. Stacks of face-on 1-D and 2-D detectors are described in Nelson Patent No. 4,937,453. Arrays of edge-on and stacks of face-on 2-D or 3-D detectors can function as both Compton scatterers and Compton scatter detectors (see Figures 1,3). Furthermore, arrays of edge-on detectors can be stacked (Figure 2) "on-edge". Multiple materials can be used within a stack or within an edge-on array (see Figures 2,3). Furthermore, the Compton configurations described can be used for conventional (non-Compton scatter) nuclear medicine imaging (SPECT, PET). "All 3 configurations may be used for conventional imaging."

3. Two cited patents are considered to be highly relevant for this response since they demonstrate the Inventors' knowledge of: 1-D and 2-D edge-on semiconductor and scintillator detectors, assembling arrays of 1-D or 2-D edge-on detectors to form 2-D or 3-D edge-on area detectors, the use of multiple materials, and the stacking of 1-D and 2-D scintillator and semiconductor detectors for ionizing radiation detection in x-ray radiography. **I)** Patent No. 4,560,882 (Nelson R, Barbaric Z) issued Dec. 24, 1985 describes edge-on x-ray imaging using edge-on 1-D (Figure 1) and 2-D (Figures 9, 10) scintillator detectors. The 2-D edge-on scintillator detectors offer energy resolution through two mechanisms: discrete depth resolution due to discrete scintillator elements assembled (stacked) along the vertical direction and the ability to vary the scintillator phosphor material that comprises the discrete scintillator elements as a function of depth (p.6, lines 3-30). This edge-on 2-D scintillator detector design is inherently a "stacked" design (Figures 9,10). **II)** Patent No. 4,937,453 (Nelson R) issued June 26, 1990 describes the use of edge-on, 1-D semiconductor detectors for slit and area x-ray radiography imaging (see Fig. 1,3). The segmenting or dividing of edge-on annular or strip detector (essentially creating "pixels" along the readout strips) in order to obtain energy-dependent information is described (p.8, lines 28-32), creating 2-D edge-on semiconductor detector that offer energy (depth-dependent) resolution for x-ray radiography imaging. An area x-ray detector comprised of an array of edge-on 2-D detectors is a 3-D detector. Figures 5, 6 show stacking of face-on 1-D and 2-D semiconductor detectors, creating 2-D and 3-D detectors with depth resolution. Stacking of 2-D phosphor detectors is also described as well as the use of multiple detector materials (p.8, lines 9-52).

4. Patent No. 6,583,420 B1 (Nelson R., Nelson W.) issued 6-24-2003 is the basis (along with the three abandoned CIPs) for this CIP. Patent No. 4,560,882 (Nelson R, Barbaric Z) issued Dec. 24, 1985 and Patent No. 4,937,453 (Nelson R) issued June 26, 1990 are cited in this patent. The Background section is used to describe common detector geometries used in nuclear medicine including planar gamma cameras and Compton gamma cameras as well as PET ring detectors (p.2, lines 1-46). Examples of PET ring and spherical detector formats employing edge-on detectors are shown in Figures 2a,2b. This invention offers improved imaging capabilities for gamma cameras, PET cameras, and Compton cameras. In the Summary of the Invention section the use of semiconductor detectors with different properties within a detector array is specified (p.3, lines 15-20; 38-44) and that semiconductor detectors can be replaced by other detectors such as scintillation detectors, gas detectors, etc. (p.4, lines 50-53). (See also p.6, lines 47-53; p.8, lines 9-17.) The second-to-last paragraph in the Summary section is significant (p.5, lines 8-49) in that it explains many important aspects of the invention. **I)** Devices detailed in prior inventions for slit-scan and slot-scan radiographic x-ray imaging (requiring arrays of detectors) in which photons are detected directly using edge-on array detectors ...(p.5, lines 8-16) are incorporated into this invention. (Relevant devices are edge-on 1-D and 2-D semiconductor detectors and 2-D scintillator detectors.) Explicitly, this includes edge-on scintillator detectors and other detectors (p.5, lines 25-32 and p.7, lines 49-56). **II)** Aperture resolution combined

with 1-D and 2-D (depth of interaction) resolution are features of this Invention. (Within the pending application the electronically-determined interaction height refers to the event location across the "height" of the aperture. This aperture resolution capability is also referred to as 'sub-aperture resolution'.) Edge-on radiation detector designs include semiconductor drift chamber, single-sided strip, and double-sided strip detectors. Double-sided parallel strip detectors can collect electrons and holes to provide 2-D position information across the aperture (the information may also be used to correct for location-dependent energy losses during readout and timing errors). A 1-D edge-on detector with aperture resolution functions as a 2-D edge-on detector. If the double-sided detector has readout strips that are perpendicular (crossed strips), then depth-of-interaction resolution is available. By collecting electrons and holes at anode and cathode strips, a 3-D edge-on crossed strip detector with aperture resolution and depth-of-interaction resolution is available. The aperture resolution feature can also be implemented with the (2-D) segmented readout strips edge-on detector (segmenting a readout strip essentially creates "pixels" along the axis of a readout strip) described in Patent No. 4,937,453 (Nelson R) issued June 26, 1990. This also can be used as a 3-D edge-on detector. The segmented design would permit higher readout rates than the crossed strips design while maintaining depth-of-interaction information in addition to aperture resolution (p.5, lines 32-49). Note that one embodiment of the invention is that the array shown in Figure 1 is designed to detect incident radiation using detector modules without attached collimators (p.7, lines 31-37). No Compton collimator is shown in Figure 1. Within nuclear medicine, only 3-D Compton gamma cameras and 3-D PET cameras typically operate without conventional collimators. **III)** A 3-D edge-on detector array intended for nuclear medicine imaging can be assembled from a large number of 2-D edge-on detectors with fixed aperture resolution (defined by the thickness of the detector plane). Since an edge-on, 2-D detector with aperture resolution is a 3-D detector, the 3-D edge-on detector array could be assembled from a smaller number of 3-D edge-on detectors with aperture resolution (potentially reducing costs significantly while increasing the active detector volume). As the requirement for finer aperture resolution (pixel resolution) in PET and SPECT increases (say from 3-4 mm to 1-2 mm) the number of fixed aperture, 2-D edge-on detectors that are needed for even a small gamma camera detector area (300 mm x 300 mm) can become quite large. (Consider a planar detector with an aperture height of 2 mm and a 30 mm width. 10 rows of 150 planar detectors would be need to cover 300 mm x 300 mm.) 1-D or 2-D Edge-on detectors with aperture resolution could be used to significantly reduce the number of edge-on detectors needed to construct a 2-D or 3-D detector for nuclear medicine imaging. In addition, energy corrections and timing corrections could be applied to the detected signals. **IV)** To summarize, it is well understood in the art of nuclear medicine imaging that 3-D detection capability is useful for PET and Compton scatter imaging, and that it would be useful for SPECT imaging. . The issued Patent No. 6,583,420 B1 (6-24-2003) establishes edge-on, 3-D detector modules (in addition to edge-on, 2-D detector modules) based on arrays of edge-on 2-D semiconductor and 2-D scintillator detectors with fixed apertures. The 3-D semiconductor array design is enhanced by using an array of edge-on, 3-D detectors (2-D detectors with

aperture resolution). 2-D semiconductor array designs can be enhanced in a similar manner by using 1-D detectors with aperture resolution. Specifically, see Claims 1, 7. The 3-D edge-on detectors can be used with collimators (Compton, PET, gamma camera) and without collimators (Compton, PET). Stacking detectors and using multiple detector materials is described. A 3-D Compton camera clearly provides two capabilities (detecting scatter events and absorption events) since it functions "as a scatterer and as an absorber". A 3-D PET camera must provide at least one capability (detecting absorption events) and it benefits if it can detect scatter events. In this sense 2-D and 3-D PET camera (and gamma cameras) capabilities are inherently present in 3-D Compton cameras.

5. Examiner cites El-Hanany, et al. (US Pre-grant publication 20030010924 A1) who describe using a stack (an array) of edge-on, thin 2-D (pixilated anode) semiconductor detectors (CdZnTe) to provide depth of interaction (point of interaction in three dimensions). Two assemblies of edge-on detectors can be used to create a PET detector. Multiple interactions (the path of the photon) within an assembly can be 'tracked'. A single assembly can be used as a Compton telescope.

6. Examiner cites Lingren, et al. (Patent No. 6,046,454) who describe electrode design improvements to 2-D pixel or cross strip CdZnTe detectors. These 2-D detectors can be used with a side-entry detector array structure. DOI can be determined with side-entry, useful for PET and image reconstruction using coded masks. Pixels can be tied together to form one big pixel in the direction of the incoming radiation.

7. Examiner cites Nygren (Patent No. 5,434,417) who describes an edge-on segmented strip detector that provides depth of penetration information.

8. Examiner cites Phoh, et al. (Patent No. 5,400,379) who describe using a moveable x-ray mask to block radiation and alternately divide the single detector ring into a first detector ring and then an adjacent second detector ring.

9. Response to item 1, Examiner's objection to claim 9 limitation "the detector layers" in lines 1-2. Inventors note that this term "layers" is used within the pending patent application to describe the combination of 1 or a stack of face-on 2-D detectors (Figure 8) on the front-end with a back-end edge-on gamma camera (p. 36, lines 5-22 and p.37, lines 1-2 and p.47, lines 9-14).

10. Response to item 3, Examiner's objections to claims 1 as being anticipated by El-Hanany, et al. (US Pre-grant publication 20030010924 A1). **A)** Regarding claim 1, examiner contends that El Hanany discloses an enhanced Compton gamma camera in claim 10, a plurality of detector modules in claim 11, at least one edge-on detector, communication links. Inventors respond that El Hanany's claims 10,11 refer to PET cameras (two detector assemblies, eliminating parallax errors). El Hanany in claim 12 cites a Compton telescope camera with a single detector assembly. Inventors contend that El-Hanany describes monolithic array assemblies and not modules. Inventors contend that El-Hanay does not describe an enhanced

gamma camera which Inventors define on page 11, lines 20-23: "Edge-on Compton, PET, and gamma (SPECT) cameras that utilize interaction height or interaction depth information to enhance resolution will be referred to as "enhanced" edge-on, Compton, PET, and gamma (SPECT) cameras, respectively." As explained in Remarks 2 and 4, interaction height and interaction depth are determined electronically as the location between the anode and cathode (along the thickness of the detector plane) for edge-on and face-on detectors, respectively. For edge-on detectors this represents sub-aperture resolution capability. For face-on detectors this represents resolution along the thickness direction. An edge-on or face-on 2-D detector with interaction height (sub-aperture) or interaction depth resolution, respectively, functions as a 3-D detector. Furthermore, El-Hanany describes the use of semiconductor radiation detectors whereas Inventors describe implementations based on semiconductor and/or scintillator detectors. Inventors filed Express Abandonment forms on March 22, 2005 for three CIP applications (10/446,239; 10/452,459; 10/462,191) under review by Ms. Otilia Gabor (Art Unit 2878). The subject matter disclosed in CIP Application no.10/648,687 is a continuation of CIP Application no. 10/462,191 (filed 6-16-2003), which is a continuation of CIP Application no. 10/452,459 (filed 6-03-2003), which is a continuation of CIP Application no. 10/446,239 (filed 5-29-2003). The filing dates for these abandoned CIP applications were prior to the issue date of Patent No. 6,583,420 B1 (6-24-2003). Inventors' understanding is that claims made in these three CIP applications that are based on material disclosed in the original Patent No. 6,583,420 B1 benefit from its 6-07-2000 filing date. The use of electronically-determined interaction height information for edge-on semiconductor detectors was defined by Inventors in Patent No. 6,583,420 B1. The use of arrays of edge-on 2-D semiconductor detectors (or scintillator detectors) to form a 3-D Compton camera was defined in Patent No. 6,583,420 B1.The use of electronically-determined interaction height information (sub-aperture resolution) for edge-on 1-D and 2-D scintillator detectors is defined in this pending Application. The use of communication links to transfer data was defined in Patent No. 6,583,420 B1. The filing date of Patent No. 6,583,420 B1 and the date of the Disclosure document No. 464163 (10-25-1999) precede El-Hanany's international and US filing dates.

11. Response to item 3, Examiner's objections to claim 2 as being disclosed by El-Hanany as prior art (Wainer et al.), a stack of edge-on 1-D detectors. Inventors note that this "stack" is irradiated edge-on and thus is no longer serves the function of a stack (multiple layers) but is rather an "array" of edge-on planar detectors. The Inventors'"strip" radiation detector refers to a face-on detector used with an enhanced Compton camera. Such a strip detector (see Figure 8) can be a 2-D planar strip detector or a 2-D planar strip detector with electronically-determined interaction depth capability (by using electron and hole information), thus a face-on 3-D detector (p.37, lines 11-15 and p.46, lines 11-22). A stack of such face-on detectors refers to multiple layers of face-on detectors. Inventors claim priority based on the filing date of Patent No. 6,583,420 B1.

12. Response to item 3, Examiner's objections to claim 3-4 in that El-Hanany discloses limitations set forth in claim 1, but does not specify that detectors and modules will have different properties. Examiner states that there will always be small variations within a detector and between detectors and thus this is obvious. Inventors describe the different properties of detectors and detector modules (p.19, lines 6-11) including energy resolution, spatial resolution, stopping power, and readout rates. Inventors account for the small variations between detectors and detector modules by calibration (tuning). Inventors describe varying edge-on detector thickness, spatial resolution, and material (p. 45, lines 20-23 and p. 46, lines 1-11). Inventors claim priority based on the filing date of Patent No. 6,583,420 B1.

13. Response to item 3, Examiner's objections to claim 5 as being disclosed by El-Hanany as prior art. Inventors note that the prior art cited specifies that "each thin detector layer has an array of anode strips", a single-sided detector. Inventors note that this is not the same as a dual-sided detector with parallel (anode and cathode) strips and certainly does not describe an enhanced detector with electronically-determined interaction height resolution (sub-aperture resolution) capability. Inventors claim priority based on the filing date of Patent No. 6,583,420 B1.

14. Response to item 3, Examiner's objections to claim 7 as being anticipated by El-Hanany who discloses that the edge-on radiation detector is a pixellated array detector. Inventors note that utilizing a 2-D pixellated array (2-D array in general) is disclosed in issued Patent No. 6,583,420 B1 (6-24-2003) and the abandoned CIPs as discussed in the response to rejection of claim 1. Furthermore, for the enhanced Compton camera the 2-D detectors have electronically-determined interaction height resolution (sub-aperture resolution) capability.

15. Response to item 3, Examiner's objections to claim 8 as being anticipated by El-Hanany who discloses that the detectors are stacked (Figure 3A). Inventors note that El-Hanany uses the words "a stack" to refer to an edge-on array of multiple, thin semiconductor crystal detectors. Inventors use the verb "stacked" to refer to detectors layered on top of other detectors (p. 46, lines 6-11 and p.47, lines 2-14) as shown in Figure 11b and 11c (in which detectors are comprised of different materials). Inventors claim priority based on the filing date of Patent No. 6,583,420 B1.

16. Response to item 3, Examiner's objections to claim 9 as being anticipated by El-Hanany who discloses that layers of the detectors use different materials (102 is made of CdZnTe, element 118 is made of polymer). Inventors note that element 118 is a PCB (printed circuit board used for readout and to supply power) and not a detector. Inventors maintain that this term "layers" is used within the pending patent application to describe the combination of 1 or a stack of face-on 2-D detectors (Figure 8) on the front-end with a back-end edge-on gamma camera (p. 36, lines 5-22 and p.37, lines 1-2 and p.47, lines 9-14).

17. Response to item 3, Examiner's objections to claim 10 as being anticipated by El-Hanany who discloses that gamma camera elements are all mounted and adjusted before use. Inventors specify that detectors and modules can be adjusted by mechanical operations such as tilting (p.46, lines 22-23 and p.47, lines 1-2) or elevating (p. 48, lines 16-21). Inventors do not specify "before use" since this represents a dynamic capability. Inventors maintain that these mechanical capabilities are not related to El-Hanany's invention.

18. Response to item 3, Examiner's objections to claim 15 as being anticipated by El-Hanany who discloses that the camera operates as an enhanced edge-on gamma camera. Inventors note that El-Hanany discloses two "3-D" gamma cameras intended to function together (as coincidence detectors) as a PET camera. There is no description provided that these two detectors are intended to be used as 3-D or 2-D conventional gamma cameras (for which coincidence is not important). In the Background (paragraphs [004], [0005]) El-Hanany describes a co-pending application in which a stack of face-on 2-D detectors (interconnected) are used in a conventional gamma camera with increased stopping power. But the interconnections ensure that there is no depth of interaction information (which makes it unsuitable for PET imaging). Hence El-Haneny's need for a design that provides a 3-D detector. Inventors note that utilizing arrays of edge-on (and face-on) 1-D and 2-D detectors for Compton, PET, and gamma camera imaging is disclosed in issued Patent No. 6,583,420 B1 (6-24-2003) and the abandoned CIPs as discussed in the response to rejection of claim 1. Furthermore, for the enhanced Compton camera the 1-D and 2-D detectors have electronically-determined interaction height (sub-aperture resolution) capability (and interaction depth capability) that can be employed in enhanced 2-D and 3-D gamma cameras.

19. Response to item 3, Examiner's objections to claim 16 as being anticipated by El-Hanany who discloses that the camera acts as enhanced edge-on PET detector. Inventors note that utilizing arrays of 1-D and 2-D detectors for Compton, PET, and gamma camera imaging is disclosed in issued Patent No. 6,583,420 B1 (6-24-2003) and the abandoned CIPs as discussed in the response to rejection of claim 1. Furthermore, for the enhanced Compton camera the 1-D and 2-D detectors have electronically-determined interaction height (sub-aperture resolution) capability (and interaction depth capability) that can be employed in 2-D and 3-D PET gamma cameras (p. 45, lines 20-23 and p. 46, lines 1-22). Inventors' PET camera designs include 2-D and 3-D detector modules as well as enhanced 2-D and 3-D detector modules.

20. Response to item 3, Examiner's objections to claims 14 and 17 as being anticipated by El-Hanany who discloses that the camera detects radiation. Inventors note that El-Hanany limits his discussion of radiation to photons (this is a detector intended for PET imaging). Inventors' detector designs can be used for photons (including simultaneous imaging of high and low energy photons), neutrons (neutral particles), and charged particles. Inventors note that detecting radiation for Compton, PET, and gamma camera imaging is disclosed in issued Patent No. 6,583,420 B1 (6-24-

2003) and the abandoned CIPs as discussed in the response to rejection of claim 1. Enhanced Compton cameras can employ 1-D and 2-D detectors that have electronically-determined interaction height (sub-aperture resolution) capability (and interaction depth capability). Inventors describe imaging of low and high energy photons and particles (p. 36, lines 5-22 and p. 37, lines 1-2). Inventors describe the use of neutron and electron optics collimators with cameras (p.6, lines 3-8). Inventors provide additional details concerning detecting multiple types of particles and particles with a range of energies and the advantage of using more than one detector material (p. 47, lines 21-23 and p. 48, lines 1-16).

21. Response to item 3, Examiner's objections to claim 18 as being anticipated by El-Hanany who discloses that the camera is used for radiographic imaging. Inventors note that although El-Hanany includes the term "x-ray" in paragraph [0001] there is no explanation of how or why his edge-on 3-D semiconductor detector array would be used for radiographic imaging. Inventors note that certain nuclear medicine isotopes are x-ray and gamma ray emitters (p.5, lines 11-13). Inventors cite applications in x-ray radiography (including multiple energy imaging), CT (p. 39, lines 1-18), simultaneous x-ray radiography and nuclear medicine imaging (p. 36, lines 5-13), radiation therapy imaging and industrial radiography (p.51, lines 15-21), and non-x-ray radiography such as neutron radiography (p.32, lines 7-11) that benefit from the edge-on detector designs as well as enhanced edge-on detector designs (sub-aperture resolution and interaction depth capability). Focused detector designs with x-ray optics or non-x-ray optics can be used to enhance radiographic imaging (p. 53, lines 8-23 and p. 54, lines 1-3 as well as p.69, lines 3-13). Inventors note that radiographic imaging by x-rays and particles such as neutrons using edge-on and enhanced edge-on Compton gamma cameras (and therefore PET and gamma cameras) is disclosed in issued Patent No. 6,583,420 B1 (6-24-2003) and the abandoned CIPs as discussed in the response to rejection of claim 1.

22. Response to item 3, Examiner's objections to claim 19 as being anticipated by El-Hanany who discloses that the camera is used for radiographic imaging and thus CT radiographic imaging by extension. Inventors describe CT imaging including the use of enhanced edge-on detectors that offer sub-aperture resolution and improved energy resolution (p. 39, lines 1-18). Inventors note that radiographic CT imaging by x-rays using edge-on and enhanced edge-on Compton gamma cameras (and therefore PET and gamma cameras) is disclosed in issued Patent No. 6,583,420 B1 (6-24-2003) and the abandoned CIPs as discussed in the response to rejection of claim 1.

23. Response to item 3, Examiner's objections to claim 20 as being anticipated by El-Hanany who discloses that the camera is irradiated from the side. Inventors note that the edge-on side irradiation geometry described in their application is a non-standard implementation of edge-on imaging with semiconductor detector arrays such that the readout electronics is located at the side of the radiation entrance surface rather than opposite (the back-end) the (front-end) radiation entrance surface (Figure 1). This edge-on side readout arrangement is currently how edge-on

scintillator detectors are readout. (See Nelson, Patent No. 4,560,882, Figures 1, 2,3, 7, 9, 10. In particular, Figure 9 demonstrates the simplicity of "stacking" the same or different materials using the side readout arrangement.) This geometry can be attractive for those cases in which the readout electronics should be removed from line-of-sight irradiation, a limited imaging area is acceptable, or stacking detectors (possibly of different materials, etc.) would be beneficial. For example, additional detectors are added along a row (say, the Y axis) of the array rather than on top of the array (the vertical or Z axis) as seen in Figure 11b. El-Hanany does not describe such an edge-on "side" detector geometry. El-Hanany's Figure 3A shows the interface to the edge-on 2-D detector array at the back-end with radiation incident at the front-end. This is the same geometry as shown in Inventors' Figure 1.

24. Response to item 3, Examiner's objections to claim 21 as being anticipated by El-Hanany who discloses an edge-on radiation detector (figure 3A) wherein interaction height information or depth of interaction is used to determine sub-aperture resolution (paragraph [0034]). Inventors note that El-Hanany determines DOI information by the column of the pixel that detects an event along the Z-direction, accuracy is dependent on the anode pixel pitch in the Z-direction. This represents a "hard-wired" DOI defined by the pixel geometry in an edge-on orientation that is also described by the Inventors (a 2-D detector irradiated edge-on). This is the conventional use of DOI that is employed in face-on, 3-D PET imaging, depth along the Z-direction. Aperture resolution is also "hardwired" being defined by the thickness of the 2-D detector. Inventors note that DOI capability is disclosed in the Disclosure document No. 464163 (10-25-1999), the issued Patent No. 6,583,420 B1 (6-24-2003), and the abandoned CIPs as discussed in the response to rejection of claim 1. The semiconductor detector designers typically use the term 'interaction depth' to refer to the location of an ionizing radiation event between the anode and cathode sides of a pixel when irradiated face-on. This interaction depth along the thickness of the pixel is determined electronically by evaluating the anode and cathode signals. If the pixel is turned "edge-on" then the pixel thickness is now defined as the aperture height in the edge-on geometry. Electronically determining the interaction depth between anode and cathode of an event is now defined as the interaction height (or aperture height) location in the edge-on geometry. This is what is meant by sub-aperture resolution (p. 11, lines 9-23 and p. 12, lines 1-23 and p.13, lines 1-2). Specifically, "enhanced edge-on Compton, PET, and gamma (SPECT) cameras utilize interaction height or interaction depth information (p. 11, lines 20-23 and p.46, lines 6-22). This applies to edge-on and face-on detectors. Furthermore, Inventors extend the concept of aperture height information to include edge-on scintillator detectors. El-Hanany does not suggest that his 2-D edge-on semiconductor detectors that provide conventional "hard-wired" DOI resolution have interaction height (sub-aperture) resolution. Inventors note that electronically-determined interaction height and interaction depth capabilities are disclosed in the Disclosure document No. 464163 (10-25-1999), the issued Patent No. 6,583,420 B1 (6-24-2003), and the abandoned CIPs as discussed in the response to rejection of claim 1.

25. Response to item 3, Examiner's objections to claim 22 as being anticipated by El-Hanany who discloses that the radiation detector is a semiconductor detector (paragraph [0016]). Inventors note that this information is disclosed in the Disclosure document No. 464163 (10-25-1999), the issued Patent No. 6,583,420 B1 (6-24-2003), and the abandoned CIPs as discussed in the response to rejection of claim 1.

26. Response to item 3, Examiner's objections to claim 23 as being anticipated by El-Hanany who discloses radiation detector is a scintillator or crystal array detector (paragraph [0016]). Inventors note that El-Hanany's crystal refers to a semiconductor crystal since he refers to a "two-dimensional pixellated anode array formed on one planar surface. A cathode is formed on the opposite planar surface, preferably covering the substantially all of the surface." In paragraph [0018] El-Hanany refers to "electron-holes pairs… charge carriers are distributed between adjacent pixels" which is a clear indication that the detector is a semiconductor detector. Scintillator signals are optical in nature and thus require a photodetector for conversion to an electronic signal. Inventors note that this information is disclosed in the issued Patent No. 6,583,420 B1 (6-24-2003), and the abandoned CIPs as discussed in the response to rejection of claim 1.

27. Response to item 6, Examiner's objections to claims 11,12 as being anticipated by El-Hanany. Inventors' claim 11 cites claim 10 and specifies near-edge-on imaging. Inventors note that claim 10 addressed detectors and modules that can be adjusted dynamically by mechanical operations such as tilting (p.46, lines 22-23 and p.47, lines 1-2) or elevating (p. 48, lines 16-21). These mechanical features are unrelated to any electronic features disclosed by El-Hanany. Inventors show a near-edge-on detector geometry in Figure 11d (p.15, lines 7-11 and p.47, lines 1-2 and p. 50, lines 17-23 and p. 51, lines 1-8). The detector configuration disclosed by Nygren (US Patent 5,434,417 A) in Figure 5 is also unrelated to the mechanical manipulation capability of tilting or elevating detectors or detector modules as described by the Inventors. Claim 10 and claim 11 are not directed to allowing for convenient electrical connection between the processor and the detector. Inventors' claim 12 describes a coarse Compton collimator mounted on an enhanced Compton gamma camera such that it restricts the acceptance angle of incident radiation. Inventors note that this collimator is counter-intuitive to the principle of a Compton gamma camera that uses no collimation and it differs from a conventional gamma camera collimator in that the holes are much larger (they no longer define the limiting spatial resolution of the camera) and the collimator is much lighter (p.49, lines 1-23 and p.50, lines 1-5). Inventors contend that claim 1 is valid. The collimator disclosed by Nygren in Figure 5 is just an ordinary x-ray radiographic collimator and would obviate a major advantage (a large acceptance aperture) of a Compton camera since it would define a very narrow acceptance angle (nearly perpendicular to the entrance face of the detector) for each of the collimator holes. Coarse collimator holes ensure that the acceptance angle for the Compton camera remains significantly larger than for a gamma camera with standard collimator while avoiding the drawback that positioning errors become problematic for Compton

cameras when radiation is incident at very large acceptance angles. The course Compton collimator would not be useful if deployed with a conventional gamma camera or for radiographic x-ray imaging.

28. Response to item 7, Examiner's objections to claim 6 as being anticipated by El-Hanany in conjunction with the disclosure of Lingren. Inventors acknowledge that Lingren discloses the use of dual-sided cross strip detectors that represent one type of 2-D detector (with a reduced readout speed capability). Lingren does not disclose a 2-D detector with electronically-determined aperture height (sub-aperture resolution) capability. Inventors contend that claim 1 is valid. Inventors note that this information is disclosed in the Disclosure document No. 464163 (10-25-1999), the issued Patent No. 6,583,420 B1 (6-24-2003), and the abandoned CIPs as discussed in the response to rejection of claim 1.

29. Response to item 8, Examiner's objection to claim 13 as being unpatentable over El-Hanany in view of Nygren and Pfoh (US Patent 5,400,379 A). Claim 13 refers to a coarse Compton collimator wherein a radiation shield covers specific edge-on radiation detectors. Inventors contend that claim 12 is valid. El-Hanany never expresses the need to include a collimator with a Compton camera and Nygren's collimator is used to limit incident x-ray radiation to eliminate off-axis (assumed to be scattered) radiation. Phoh describes a collimator useful for increasing the apparent number of CT scanner detector rings (the spatial resolution along the axis of the CT "cylinder") without increasing the number of rings. This is achieved by moving a collimator along the axis of the cylinder such that (for example) ½ of a detector element is exposed (representing ring one). Next the collimator moves ½ pixel and the second half of the pixel is illuminated (representing ring two). Thus this is a dynamic collimator with the limitation that adjacent rows of pixels cannot be irradiated simultaneously. Inventors disclose a fixed radiation shield that covers specific edge-on detectors within a Compton camera as shown in Figure 11c (p.15, lines 1-6 and (p.49, lines 1-17). While the shield is intended to prevent direct irradiation of a detector or detector module, the detector or detector module still functions as an active, independent, edge-on detector which will preferentially receive radiation from the side rather than edge. Its role is to detect Compton scatter radiation with minimal "noise" from direct radiation. Thus, this coarse Compton collimator is not used to selectively define spatial resolution, the function of the Phoh CT collimator. Inventors contend that the coarse Compton collimator is functionally distinct from the collimator disclosed by Phoh and would not be useful for CT imaging.

CONCLUSION

Applicants respectfully submit that they have addressed the Examiner's objections. Applicants respectfully request that the Examiner reconsider and withdraw the outstanding rejections and allow the present application. Applicants invite the

Examiner to telephone the undersigned representative if the Examiner believes that a telephonic interview would help advance this case to allowance.

Respectfully submitted,

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